

**WHAT IS CLAIMED:**

- 1           1.       A method for biological burden reduction, comprising a step of applying a  
2       continuous stream of  $O_x$  to a material in a sealed biological burden reduction chamber,  
3       wherein said  $O_x$  includes oxygen and its radicals.
- 1           2.       The method of claim 1, wherein  $O_x$  is selected from an integer from 1 to 3.
- 1           3.       The method of claim 1, further comprising continuously withdrawing  $O_x$   
2       from said sealed biological burden reduction chamber.
- 1           4.       The method of claim 1, further comprising creating a pressure differential  
2       within said biological burden reduction chamber and maintaining said pressure differential  
3       while continuously applying said stream of  $O_x$  to said material.
- 1           5.       The method of claim 4, further comprising agitating said  $O_x$  in said biological  
2       burden reduction chamber to increase permeation of said  $O_x$  into said material.
- 1           6.       The method of claim 5, wherein forced air is used to agitate said  $O_x$ .
- 1           7.       The method of claim 5, wherein said agitating distributes said  $O_x$  evenly  
2       throughout said biological burden reduction chamber.
- 1           8.       The method of claim 5, further comprising
  - 2               (a)     creating a vacuum within said biological burden reduction chamber;
  - 3               (b)     generating  $O_x$  in an  $O_x$  generation cell;
  - 4               (c)     withdrawing a stream of  $O_x$  from said  $O_x$  generation cell into said  
5       biological burden reduction chamber; and
  - 6               (d)     withdrawing  $O_x$  from said biological burden reduction chamber.
- 1           9.       The method of claim 4, wherein said  $O_x$  generation cell comprises an  $O_x$   
2       generator capable of generating  $O_x$  at a pressure of less than 20 lbs/in<sup>2</sup> selected from one or

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1            16.    The method of claim 13, further comprising controlling water vapor present  
2    in said continuous stream of  $O_x$  prior to applying said continuous stream of  $O_x$  to said  
3    material.

**Figure 6**

- 1 17. The method of claim 12, wherein said pressure within said biological burden  
2 reduction chamber is maintained between about 0 psia and 20 psia.
- 1 18. The method of claim 1, wherein said  $O_x$  is generated from ambient air or  
2 components of ambient air.
- 1 19. The method of claim 1, wherein said  $O_x$  is generated from other oxygen  
2 sources including gaseous oxygen, liquid oxygen,  $H_2O$  and mercuric oxide.
- 1 20. The method of claim 1, wherein the material is a food product.
- 1 21. The method of claim 1, wherein the material is a medical product.
- 1 22. The method of claim 1, wherein the material is a cosmetic ingredient.
- 1 23. The method of claim 1, wherein the material is a dietary supplement.
- 1 24. The method of claim 1, wherein the material is a botanical.
- 1 25. The method of claim 1, wherein the material is a nutraceutical.
- 1 26. The method of claim 1, wherein the material is a pharmaceutical ingredient.
- 1 27. The method of claim 1, wherein the material is a packaging material.
- 1 28. The method of claim 1, wherein the material is a nursery stock product.
- 1 29. The method of claim 1, wherein the material is a color additive.
- 1 30. The method of claim 1, wherein the material is a seed.
- 1 31. The method of claim 1, wherein the material is a personal care product.
- 1 32. The method of claim 1, wherein the material is an animal feed.
- 1 33. The method of claim 1, wherein the material is a flavoring.
- 1 34. An apparatus for biological burden reduction, comprising:  
2 (a) a biological burden reduction chamber;  
3 (b) a vacuum pump coupled to said biological burden reduction chamber;

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4 (c) an  $O_x$  generation cell, wherein said  $O_x$  generation cell comprises a  
5 means for generating  $O_x$ ;

6 (d) a first control valve coupled to said biological burden reduction  
7 chamber and said  $O_x$  generation cell, wherein said first control valve is capable of permitting  
8 said  $O_x$  to be withdrawn from said  $O_x$  generation cell into said biological burden reduction  
9 chamber; and

10 (e) a second control valve coupled to said biological burden reduction  
11 chamber, wherein said second control valve is capable of withdrawing  $O_x$  contained within  
12 said biological burden reduction chamber.

1 35. The apparatus of claim 34, further comprising a member for creating forced  
2 air contained within said biological burden reduction chamber, wherein said forced air  
3 distributes said  $O_x$  evenly throughout said biological burden reduction chamber.

1 36. The apparatus of claim 34, further comprising a temperature-regulating  
2 means.

1 37. The apparatus of claim 34, further comprising a means for controlling water  
2 vapor coupled to said biological burden reduction chamber.

1 38. The apparatus of claim 34, further comprising a controller for controlling and  
2 monitoring physical parameters within said biological burden reduction chamber.

1 39. The method of claim 1, wherein said biological burden is selected from a  
2 group of living entities including insects, bacteria, viruses, algae, yeasts, molds, nematodes,  
3 parasites and weed seed.

1 40. The apparatus of claim 36, further comprising a means to convert said  $O_x$  to  
2  $O_2$  prior to release into atmosphere.

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1            42.    The method of claim 4, wherein a temperature within said biological burden  
2    reduction chamber is between about 32°F and about 80°F.

43. The method of claim 1, wherein a flow rate of said continuous stream of O<sub>x</sub> within said biological burden reduction chamber is between about 0.1 L/min/ft<sup>3</sup> and about 2 L/min/ft<sup>3</sup>.

1            44.    The method of claim 1, further comprising applying a continuous stream of  
2    one or more of a gas selected from the group consisting of N<sub>2</sub>, CO<sub>2</sub> and Ar in addition to  
3    said continuous stream of O<sub>2</sub>.

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